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# THE 1973 NASA PAYLOAD MODEL

October 1973

## SPACE OPPORTUNITIES
## 1973-1991


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# THE 1973 NASA PAYLOAD MODEL

## CONTENTS

The tables in this document contain schedules and descriptions which portray the 1973 NASA Payload Model. The schedules cover all NASA programs and the anticipated requirements of the user community, not including the Department of Defense, for the 1973 to 1991 period. The descriptions give an indication of what the payload is expected to accomplish, its characteristics, and where it is going. The payload flight schedules shown for each of the discipline areas indicate the time frame in which individual payloads will be launched, serviced, or retrieved. These do not necessarily constitute Shuttle flights, however, since more than one payload can be flown on a single Shuttle flight depending on size, weight, orbital destination, and the suitability of combining them. The weight, dimension, and destination data represent approximations of the payload characteristics as estimated by the Program Offices. Payload codes are provided for easy correlation between the schedules and descriptions of the Payload Model and subsequent documentation which may reference this model.

This Payload Model is not a NASA program plan. Rather, the Payload Model represents a baseline set of possible future payloads which can be used as a reference base for planning purposes. One aspect of current planning activities deals with the effective utilization of the Shuttle, Space Tug, and Sortie Lab, all payload carriers that will support science and applications objectives for the future. The payload data included in the Model can therefore serve as a guide in the design of these carriers; for studies concerning their operation and utilization; and the evaluation of operational and physical interfaces between them.

This Payload Model was prepared under the direction of the Mission and Payload Integration Office of NASA Headquarters by the Mission and Payload Planning Office, Program Development, at Marshall Space Flight Center based on requirements provided by the Program Offices.

PE Culbertson

PHILIP E. CULBERTSON
Director, Mission and Payload Integration Office
NASA Headquarters, Washington D.C.

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TABLE 1. 1973-1991 TOTAL PAYLOAD SUMMARY

| | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NASA | | | | | | | | | | | | | | | | | | | | |
| Automated | 6 | 8 | 7 | 7 | 11 | 10 | 16 | 17 | 22 | 13 | 15 | 17 | 20 | 23 | 21 | 15 | 18 | 21 | 19 | 286 |
| Sortie | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 17 | 21 | 22 | 25 | 27 | 28 | 26 | 28 | 27 | 27 | 27 | 286 |
| Total | 6 | 8 | 7 | 7 | 11 | 10 | 16 | 28 | 39 | 34 | 37 | 42 | 47 | 51 | 47 | 43 | 45 | 48 | 46 | 572 |
| Non-NASA/Non-DoD | | | | | | | | | | | | | | | | | | | | |
| Automated | 6 | 10 | 10 | 8 | 9 | 13 | 7 | 8 | 10 | 9 | 10 | 8 | 9 | 12 | 6 | 19 | 9 | 17 | 8 | 188 |
| Sortie | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 3 | 4 | 3 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 50 |
| Total | 6 | 10 | 10 | 8 | 9 | 13 | 7 | 10 | 13 | 12 | 14 | 11 | 14 | 17 | 11 | 24 | 14 | 22 | 13 | 238 |
| Grand Total | 12 | 18 | 17 | 15 | 20 | 23 | 23 | 38 | 52 | 46 | 51 | 53 | 61 | 68 | 58 | 67 | 59 | 70 | 59 | 810 |

TABLE 2. 1973-1991 AUTOMATED PAYLOAD SUMMARY

| | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NASA | | | | | | | | | | | | | | | | | | | | |
| Astronomy | 2 | 2 | 2 | 1 | 2 | 4 | 2 | 5 | 2 | 4 | 5 | 4 | 7 | 6 | 7 | 5 | 6 | 5 | 6 | 77 |
| Physics | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 4 | 3 | 4 | 4 | 43 |
| Planetary | 1 | 1 | 2 | 2 | 2 | 2 | 5 | 2 | 7 | 0 | 3 | 4 | 5 | 5 | 2 | 0 | 2 | 2 | 2 | 49 |
| Lunar | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 8 |
| Life Sciences | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 26 |
| Earth Observations | 1 | 2 | 0 | 2 | 3 | 3 | 3 | 3 | 4 | 3 | 3 | 2 | 4 | 2 | 6 | 2 | 4 | 2 | 4 | 53 |
| Earth and Ocean Physics | 0 | 1 | 0 | 1 | 1 | 0 | 2 | 2 | 4 | 2 | 0 | 0 | 1 | 4 | 0 | 0 | 0 | 4 | 0 | 22 |
| Communications and Navigation | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Space Processing | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Space Technology | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 6 |
| Total | 6 | 8 | 7 | 7 | 11 | 10 | 16 | 17 | 22 | 13 | 15 | 17 | 20 | 23 | 21 | 15 | 18 | 21 | 19 | 286 |
| Non-NASA/Non-DoD | | | | | | | | | | | | | | | | | | | | |
| Communications and Navigation | 5 | 9 | 8 | 6 | 6 | 9 | 4 | 6 | 6 | 5 | 8 | 6 | 6 | 6 | 3 | 9 | 5 | 9 | 4 | 120 |
| Earth Observations | 1 | 1 | 2 | 2 | 3 | 4 | 3 | 2 | 4 | 4 | 2 | 2 | 3 | 3 | 3 | 7 | 4 | 5 | 4 | 59 |
| Earth and Ocean Physics | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 3 | 0 | 3 | 0 | 9 |
| Total | 6 | 10 | 10 | 8 | 9 | 13 | 7 | 8 | 10 | 9 | 10 | 8 | 9 | 12 | 6 | 19 | 9 | 17 | 8 | 188 |
| Grand Total | 12 | 18 | 17 | 15 | 20 | 23 | 23 | 25 | 32 | 22 | 25 | 25 | 29 | 35 | 27 | 34 | 27 | 38 | 27 | 474 |

TABLE 3. 1980-1991 SORTIE PAYLOAD SUMMARY

| | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NASA | | | | | | | | | | | | | |
| Astronomy | 1 | 2 | 3 | 4 | 5 | 7 | 7 | 6 | 6 | 6 | 5 | 6 | 58 |
| Physics | 1 | 2 | 3 | 3 | 5 | 5 | 6 | 5 | 6 | 5 | 6 | 5 | 52 |
| Earth Observations | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 24 |
| Space Processing | 1 | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 43 |
| Earth and Ocean Physics | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 24 |
| Communication & Navigation | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 11 |
| Life Science | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 28 |
| Space Technology | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 46 |
| Total | 11 | 17 | 21 | 22 | 25 | 27 | 28 | 26 | 28 | 27 | 27 | 27 | 286 |
| Non/NASA-Non/DoD | | | | | | | | | | | | | |
| Space Manufacturing | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 10 |
| Foreign Sortie | 2 | 3 | 3 | 4 | 3 | 4 | 3 | 4 | 3 | 4 | 3 | 4 | 40 |
| Total | 2 | 3 | 3 | 4 | 3 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 50 |
| Grand Total | 13 | 20 | 24 | 26 | 28 | 32 | 33 | 31 | 33 | 32 | 32 | 32 | 336 |

# TABLE 4. ASTRONOMY PROGRAM (AST)

## Program Description

Building on past accomplishments, the payloads of the Astronomy Program provide capabilities for the further study of the structure and evolution of the universe and the laws which govern it. They will make possible surveys and detailed measurements of the various energies radiated toward us from different celestial sources.

Important objectives of these missions include: (a) measurement of the physical properties of stars and of their atmospheres; (b) description and analysis of the high energy processes inferred by past observations of quasars, pulsars, and X-ray sources; (c) understanding of physical characteristics of interstellar and intergalactic material; and (d) a search for the "edge" of the universe. Special emphasis will be placed on studies of the sun as a test bed for theories of stellar structure, behavior, and evolution leading to a better understanding of the Sun's effects on the Earth and other planets.

To achieve these objectives, explorer payloads and small observatory class payloads are required for long-term observations of specific objects. Also, large, multipurpose observatories will make available, to all qualified scientists, sophisticated viewing capabilities for necessary in-depth studies of celestial objects and phenomena. These versatile facilities will employ a variety of detectors which can be refurbished or replaced as needed. Finally, payloads on Sortie Lab flights will be used for developing instruments for these large observatories and for investigations requiring flexibility in instrumentation and quick turnaround, but relatively short in-orbit observing time.

TABLE 4. ASTRONOMY PROGRAM (AST)

| Payload Code | Payload | CY | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Automated Spacecraft | | | | | | | | | | | | | | | | | | | | | |
| AST-1 | Explorers | | ② | ① | ② | ① | ① | ② | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 26 |
| AST-2 | Orbiting Solar Obs. | | | ① | | | | | | | | | | | | | | | | | | 1 |
| AST-3 | Solar Physics Mission | | | | | | | | | | | | | | | | | | | | | 7 |
| AST-4 | High Energy Astr. Obs. A-C | | | | | | ① | ① | ① | | C′ | | | | | | | | | | | 4 |
| | Large Observatories | | | | | | | | | | | $D_1$ | | | | $E_1$ | $D_2$ | | | | $E_2$ | |
| AST-5 | High Energy Astr. Obs. D+E | | | | | | | | | | | | | | | | | | | | | 4 |
| | Revisits | | | | | | | | | | | | 1 | | 1 | | 1 | | 2 | | | 5 |
| AST-6 | Large Space Telescope | | | | | | | | | | | | | | | | | | | | | 3 |
| | Revisits | | | | | | | | | | 1 | 1 | | 1 | 1 | 1 | 1 | | 1 | 1 | 1 | 9 |
| AST-7 | Large Solar Obs. | | | | | | | | | | | | | | | | | | | | | 1 |
| | Revisits | | | | | | | | | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| AST-8 | Large Radio Obs. | | | | | | | | | | | | | | | | | | | | | 1 |
| | Revisits | | | | | | | | | | | | | | | | 1 | | 1 | | 1 | 3 |
| AST-9 | Focusing X-Ray Telesc. | | | | | | | | | | | | A | | | B | | | | | $A_1$ | 3 |
| | Revisits | | | | | | | | | | | | | 1 | 1 | | | 1 | | 1 | | 4 |
| | Total Autom. | | 2 | 2 | 2 | 1 | 2 | 4 | 2 | 5 | 2 | 4 | 5 | 4 | 7 | 6 | 7 | 5 | 6 | 5 | 6 | 77 |
| | Sortie Payloads | | | | | | | | | | | | | | | | | | | | | |
| AST-10 | Stellar | | | | | | | | | | 1 | 2 | 2 | 3 | 4 | 5 | 3 | 4 | 3 | 3 | 3 | 33 |
| AST-11 | Solar | | | | | | | | | 1 | 1 | 1 | 2 | 2 | 3 | 2 | 3 | 2 | 3 | 2 | 3 | 25 |

Notes:

◯ Approved and Ongoing

TABLE 4. ASTRONOMY PROGRAM (AST)

| PAYLOAD CODE | PAYLOAD | PAYLOAD OBJECTIVES AND DESCRIPTIONS | | |
|---|---|---|---|---|
| | | WEIGHT kg (lb) | DIMENSIONS (Length/Diameter) m (ft) | DESTINATION (Incl./Apo./Per.) km (n.mi.) |
| | <u>Automated Spacecraft</u> | | | |
| AST-1 | Explorers | Will use small automated spacecraft to perform special investigations at varying altitudes of galactic and extragalactic objects emitting in different regions of the electromagnetic spectrum. | | |
| | | 90 to 450 (200-1000) | 1/1.3 avg (3/4 avg) | Low Earth Orbit to Synchronous |
| AST-2 | Orbiting Solar Observatory | Will investigate the Sun's lower corona, chromosphere, and their interactions in the X-ray and ultraviolet spectral regions. Will study interaction between solar radiation and Earth's environment. Instrument complement will include high resolution ultraviolet spectrometer, X-ray heliometer, and high sensitivity graphite spectroscope. | | |
| | | 900 (2000) | 3/1.5 (10/5) | 33°/555 (300) Circular |
| AST-3 | Solar Physics Mission | Will measure brightness of selected solar phenomena visible in the UV, X-ray, and gamma-ray regions using OSO class spacecraft. Specific study of corona/chromosphere interactions and other characteristics through periodic refurbishment by the Shuttle. Spacecraft will be configured so that instruments provide maximum Sun viewing. For high energy regions (X- and gamma-ray) coarsely pointed instruments, including polarimeters and spectrographs, will be used | | |

TABLE 4. ASTRONOMY PROGRAM (AST)

| PAYLOAD CODE | PAYLOAD | PAYLOAD OBJECTIVES AND DESCRIPTIONS | | |
|---|---|---|---|---|
| | | WEIGHT kg (lb) | DIMENSIONS (Length/Diameter) m (ft) | DESTINATION (Incl./Apo./Per.) km (n.mi.) |
| | Solar Physics Mission (Concluded) | and for lower energy regions (UV and visible) finely pointed instruments will be used, including telescopes and spectrographs. | | |
| | | 1360 (3000) | 3/2 (10/7) | 30°/500 (270) Circular |
| AST-4 | High Energy Astronomy Observatory A-C | Will investigate detailed structure, spectra, and location of specific X-ray sources. Will search for gamma-ray sources and gamma-ray spectral lines. Will study isotopic composition of light cosmic rays and the charge composition of heavy cosmic rays. HEAO A&C will scan the sky to accomplish a broad survey. HEAO-B will investigate individual X-ray sources using a grazing incidence, high resolution X-ray telescope. Instruments on HEAO-A will include large area proportional counters, shielded scintillators, and scanning modulator collimator and, on HEAO-C, may include hodoscopes, Cerenkov counter, spark chamber, and total absorbtion shower counter. | | |
| | | 2495 (5500) | 4.8/2.4 (16/8) | 28.5°/460 (250) Circular |
| | <u>Large Observatories</u> | | | |
| AST-5 | High Energy Astronomy Observatory D+E<br>D: Cosmic and Gamma Ray<br>E: Grazing Incidence | Will determine fundamental characteristics of instellar/intergalactic matter and fields. Will measure emitted energy distribution of celestial objects, and spatial/temporal distribution of celestial radiation sources. Will perform studies of the spectra, structure, polarization, and location of selected X-ray sources, charge and energy spectra of high energy cosmic rays and will search for antimatter, for extremely heavy cosmic rays and for very high energy | | |

TABLE 4. ASTRONOMY PROGRAM (AST)

| PAYLOAD CODE | PAYLOAD | PAYLOAD OBJECTIVES AND DESCRIPTIONS | WEIGHT kg (lb) | DIMENSIONS (Length/Diameter) m (ft) | DESTINATION (Incl./Apo./Per.) km (n.mi.) |
|---|---|---|---|---|---|
| | High Energy Astronomy Observatory D+E (Concluded) | gamma-ray sources. Instruments could include superconducting magnetic spectrometer, ionization spectrometer, polarimeter, grazing incidence telescope, and total absorbtion nuclear cascade counter. | 8000 (18 000) | 5.2/4.3 (17/14) | 28.5°/371 (200) Circular |
| AST-6 | Large Space Telescope | Will extend space astronomy capability to diffraction-limited performance with 3 m (9.9 ft) diam optics. Will perform high resolution spectroscopy and imaging of planetary bodies, and stars, nebulae, and galaxies. Will measure structure of quasars and state of interstellar and intergalactic matter. | 9800 (21 600) | 13/4.3 (42/14) | 28.5°/612 (330) Circular |
| AST-7 | Large Solar Observatory | Will perform high resolution visual UV, XUV, and X-ray studies of solar structure with higher spatial and spectral resolutions. High energy instrumentation with high sensitivity and time and spatial resolution will study more energetic regions of electromagnetic spectrum. Will be equipped with photoheliograph, spectroheliograph, coronographs, etc. | 8200 (18 100) | 17.7/4.6 (58/15) | 30°/350 (190) Circular |
| AST-8 | Large Radio Observatory | Will measure low frequency spectra of discrete cosmic radio sources and obtain good angular resolution of these sources. Will consist of a central core, a rhombic antenna, and four stabilizing subsatellites. | | | |

TABLE 4. ASTRONOMY PROGRAM (AST)

| PAYLOAD CODE | PAYLOAD | PAYLOAD OBJECTIVES AND DESCRIPTIONS | | |
|---|---|---|---|---|
| | | WEIGHT kg (lb) | DIMENSIONS (Length/Diameter) m (ft) | DESTINATION (Incl./Apo./Per.) km (n. mi.) |
| | Large Radio Observatory (Concluded) | 1100 (2400) | 7.6/3 (25/10) | 28.5°/71 600 (38 600) Circular |
| AST-9 | Focusing X-Ray Telescope | Will perform studies of the spectra, structure, polarization, and location of selected X-ray sources using large grazing incidence telescopes. Will determine the physical mechanisms responsible for X-ray emissions in celestial objects and provide information necessary to understand these objects in terms of dynamics, energy release, and physical evolution. Will utilize large diameter grazing incidence telescope with advanced instrument complement at the focal point. | | |
| | A: | 8000 (18 000) | 5/2 (17/7) | 28.5°/500 (270) |
| | B: | 11 300 (25 000) | 16/4.3 (53/14) | 28.5°/500 (270) |
| | <u>Sortie Payloads</u> | | | |
| AST-10 | Stellar Astronomy Sortie | Will perform a variety of experimentation in all regions of the electromagnetic spectrum utilizing basic astronomy packages: 1.0-m liquid hydrogen cooled IR telescope, 4-m IR telescope, diffraction limited 1-m UV telescope, Schmidt telescopes, and XUV detectors. | | |
| | | 5 900-25 000 (13 000-55 000) (Includes Expendables) | 3-17.4/4.3 (10-57/14) | 28.5°/Low Earth Orbit |

TABLE 4. ASTRONOMY PROGRAM (AST)

| PAYLOAD CODE | PAYLOAD | PAYLOAD OBJECTIVES AND DESCRIPTIONS | | |
|---|---|---|---|---|
| | | WEIGHT kg (lb) | DIMENSIONS (Length/Diameter) m (ft) | DESTINATION (Incl./Apo., Per.) km (n.mi.) |
| AST-11 | Solar Physics/Astronomy Sortie | Will study the physics of the fine structure in the solar atmosphere and of high energy phenomena over a broad spectral range. Will fly instruments and test them to develop technology necessary for Large Solar Observatory. | | |
| | | 9500-19 000 (21 000-42 000) (Includes Expendables) | 7.6-15.8/4.3 (25-52/14) | 28.5°/Low Earth Orbit |

# TABLE 5. PHYSICS PROGRAM (PHY)

## Program Description

In the Physics Program, projected payloads will enable the continued study of the Earth's space environment and the sun's influence on it. Special emphasis will be placed on establishing the ties between the characteristics of this environment and variable phenomena on the Sun. These payloads will also allow the investigation of high energy particles from the cosmos, and permit the testing of theoretical descriptions of the universe such as that of general relativity.

During the 1970's, explorer payloads will have essentially completed a comprehensive survey of the properties of the Earth's space environment and its variability as influenced by the Sun. Planned for the 1980's are detailed studies of cause and effect relationships necessary to take the next step beyond mapping the environment to the realm of understanding how various forces control it. Payloads on the Sortie Lab will play a major role in this program by passively measuring in detail the magnetosphere/atmosphere interface and by actively perturbing this environment and observing the resulting effects. Regions inaccessible to the Shuttle will continue to be investigated by automated payloads.

In high energy physics, investigations of cosmic rays will be carried out using Sortie Lab payloads and will be extended to very high energy regions by the Cosmic Ray Laboratory. For the first time using space-based payloads, theories of gravitation and relativity will be subjected to very reliable tests which could lead to their verification, refinement, or rejection.

TABLE 5. PHYSICS PROGRAM (PHY)

| Payload Code | Payload | CY | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Automated Spacecraft | | | | | | | | | | | | | | | | | | | | | |
| PHY-1 | Explorers | | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 29 |
| PHY-2 | Grav. & Rel. Sat. | | | | | | | | | 1 | | | 1 | | | 1 | | | | | 1 | 4 |
| PHY-3 | Environ. Perturb. Sat. | | | | | | | | | | 1 | | | 1 | | | 1 | | | 1 | | 4 |
| PHY-4 | Helio. & Interstel. S/C | | | | | | | | | | | | | | | | | 1 | | | | 1 |
| | Large Observatories | | | | | | | | | | | | | | | | | | | | | |
| PHY-5 | Cosmic-Ray Laboratory | | | | | | | | | | | | | | | | | | | | | 1 |
| | Revisits | | | | | | | | | | | | | | | | | 1 | 1 | 1 | 1 | 4 |
| | Total Autom. | | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 4 | 3 | 4 | 4 | 43 |
| | Sortie Payloads | | | | | | | | | | | | | | | | | | | | | |
| PHY-6 | High Energy Astrophysics | | | | | | | | | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 22 |
| PHY-7 | Atmospheric and Space Physics | | | | | | | | | | 1 | 1 | 1 | 3 | 3 | 4 | 3 | 4 | 3 | 4 | 3 | 30 |

Note:

○ Approved and Ongoing

TABLE 5. PHYSICS PROGRAM (PHY)

| PAYLOAD CODE | PAYLOAD | PAYLOAD OBJECTIVES AND DESCRIPTIONS | | |
|---|---|---|---|---|
| | | WEIGHT kg (lb) | DIMENSIONS (Length/Diameter) m (ft) | DESTINATION (Incl./Apo. Per.) km (n. mi.) |
| | Automated Spacecraft | | | |
| PHY-1 | Explorers | With small automated spacecraft at different altitudes, will study magnetospheric/ionospheric structure, density, and composition, and investigate interaction of solar wind with Earth's environment. Typical instrumentation will include mass and photoelectron spectrometers, impedance and electrostatic probes, accelerators, and spectrophotometers. | | |
| | | 90-450 (200-1000) | 1/1.3 avg (3/4 avg) | High and Low, Circular and Eccentric Orbits |
| PHY-2 | Gravitational & Relativity Satellite | | | |
| | Gravity Probe-$B_1$ | Will demonstrate on-orbit performance of a cryogenically cooled, high accuracy gyro system. | | |
| | | 200 (400) | 2/1 (6.6/3.3) | 37°/500 (270) |
| | Gravity Probe-$B_2$ | Will experimentally test Einstein's general theory of relativity by measuring the precession of orthogonal gyroscopes in polar Earth orbit. | | |
| | | 460 (1020) | 3.7/2.3 (12/7.6) | 90°/426 (500) Circular |

TABLE 5. PHYSICS PROGRAM (PHY)

| PAYLOAD CODE | PAYLOAD | PAYLOAD OBJECTIVES AND DESCRIPTIONS | | |
|---|---|---|---|---|
| | | WEIGHT kg (lb) | DIMENSIONS (Length/Diameter) m (ft) | DESTINATION (Incl./Apo./Per.) km (n. mi.) |
| | Gravity Probe-C | Will test Einstein's general theory of relativity to determine the distinction between general relativity and other theories through terms of second order. Will study Sun mass quadrupole moment. Will utilize true free-fall trajectory and atomic clock to accomplish investigation. | | |
| | | 350 (770) | 2/2.6 (6.5/8.5) | Ecliptic/1.0 AU/0.3 AU |
| PHY-3 | Environmental Perturbation Satellite | | | |
| | Satellite-A | Will test theories of the magnetosphere by investigating the effects of perturbing the medium. Will introduce known perturbations with active experiments utilizing electron and ion accelerators and high power, low frequency electromagnetic wave generators. | | |
| | | 1500 (3300) | 3.7/2 (12/7) | 55° /12 800 (6900) Circular |
| | Satellite-B | Will determine the overall environmental effects of material modifications to Van Allen belt by inducing instabilities and fluctuations using the injection of cold plasma particles and chemicals of various types. | | |
| | | 4000 (8700) | 4.6/3 (15/10) | 55° /12 800 (6900) Circular |
| PHY-4 | Heliocentric & Interstellar Spacecraft | Will explore regions of the solar system that are far away from planetary bodies. Will measure characteristics of interstellar particles and fields using mass | | |

TABLE 5. PHYSICS PROGRAM (PHY)

| PAYLOAD CODE | PAYLOAD | PAYLOAD OBJECTIVES AND DESCRIPTIONS | | |
|---|---|---|---|---|
| | | WEIGHT kg (lb) | DIMENSIONS (Length/Diameter) m (ft) | DESTINATION (Incl./Apo./Per.) km (n. mi.) |
| | Heliocentric & Interstellar Spacecraft (Concluded) | spectrometers and associated instrumentation. | | |
| | | 280 (620) | 3/3 (10/10) | Escape |
| | <u>Large Observatories</u> | | | |
| PHY-5 | Cosmic-Ray Laboratory | Will investigate celestial cosmic rays and perform investigations in the following experiment groups: charge and energy spectra of cosmic ray nuclei; energy spectra of high energy electrons and positrons; isotopic composition of light elements; nucleonic antimatter detection and extremely heavy nuclei detection. | | |
| | | 20 700 (45 800) | 7.3/4.3 (24/14) | 28.5°/370 (200) Circular |
| | <u>Sortie Payloads</u> | | | |
| PHY-6 | High Energy Astrophysics Sortie | Will test new instrumentation and space observing techniques for conducting investigations in the X-ray and gamma-ray regions. Will utilize superconducting magnets and spark chambers for cosmic-ray research and X-ray mirror array to concentrate the X-ray flux for spectrometry or polarimetry. | | |
| | | 7250-17 700 (16 000-39 000) (Includes Expendables) | 7.6-13.7/4.3 (25-45/14) | 28.5°-90°/Low Earth Orbit |
| PHY-7 | Atmospheric and Space Physics Sortie | Will investigate detailed mechanisms which control near space environment of the Earth. Will use electron gun and radio transmitters to artificially perturb plasma to determine major features of wave particle interactions and production | | |

TABLE 5. PHYSICS PROGRAM (PHY)

| PAYLOAD CODE | PAYLOAD | PAYLOAD OBJECTIVES AND DESCRIPTIONS | | |
|---|---|---|---|---|
| | | WEIGHT kg (lb) | DIMENSIONS (Length/Diameter) m (ft) | DESTINATION (Incl. Apo. Per.) km (n. mi.) |
| | Atmospheric and Space Physics Sortie (Concluded) | of auroras. Will measure gaseous reaction rates by release of gases to be excited by the Sun, lasers, or electron accelerators. Will also investigate the lower atmosphere by remote sensing. | | |
| | | 13 150 (29 000) (Includes Expendables) | 18.3/4.3 (60/14) | 28.5°-90°/Low Earth Orbit |

## TABLE 6. PLANETARY EXPLORATION PROGRAM (PL)

Program Description

The payloads of the Planetary Exploration Program have been formulated to achieve a balanced exploration of the solar system rather than a concentrated emphasis on one or two planets. Thus, the schedule for planetary exploration reflects a balance between payloads for the first in-situ exploration of the outer planets and other new targets and payloads for the continued exploration of Mars and Venus.

In formulating this program for solar system exploration, a major consideration has been the development of a progressive understanding of each object of interest, so that proposed missions may build on the results and knowledge generated by their predecessors. Generally, the sequence of proposed exploration begins with Earth-based observations, followed by flyby missions, then considerably improved by orbiter missions. Details of planetary atmospheres, composition, structure, and dynamics are then investigated by atmospheric probes, followed by landers to study geology and, sometimes, biology. Finally, sample return missions to allow Earth-based analysis are proposed.

TABLE 6. PLANETARY EXPLORATION PROGRAM (PL)

| Payload Code | Payload | CY | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Approved Programs | | | | | | | | | | | | | | | | | | | | | |
| PL-1 | Mariner Venus/Mercury | | ① | | | | | | | | | | | | | | | | | | | 1 |
| PL-2 | Pioneer Jupiter Flyby | | △ | | | | | | | | | | | | | | | | | | | 0 |
| PL-3 | Helios | | | ① | | ① | | | | | | | | | | | | | | | | 2 |
| PL-4 | Viking 75 | | | | ② | | | | | | | | | | | | | | | | | 2 |
| PL-5 | Mariner Jup/Sat 77 | | | | | | ② | | | | | | | | | | | | | | | 2 |
| | Inner Planets | | | | | | | | | | | | | | | | | | | | | |
| PL-6 | Viking Orbiter/Lander 79 | | | | | | | | 1 | | | | | | | | | | | | | 1 |
| PL-7 | Surface Sample Return | | | | | | | | | | | | | 2 | | | | | | | | 2 |
| PL-8 | Satellite Sample Return | | | | | | | | | | | | | | | | | | | 1 | 1 | 2 |
| PL-9 | Pioneer Venus | | | | | | | 2 | | | | | | | | | | | | | | 2 |
| PL-10 | Inner Pl. Follow-On | | | | | | | | | 1 | 2 | | 1 | | | 1 | | | | | | 5 |
| PL-11 | Venus Radar Mapper | | | | | | | | | | | | 2 | | | | | | | | | 2 |
| PL-12 | Venus Buoyant Station | | | | | | | | | | | | | | 2 | | | | | | | 2 |
| PL-13 | Mercury Orbiter | | | | | | | | | | | | | | | | 2 | | | | | 2 |
| PL-14 | Venus Large Lander | | | | | | | | | | | | | | | | | | 2 | | | 2 |
| | Outer Planets | | | | | | | | | | | | | | | | | | | | | |
| PL-15 | Mariner Jup/Uranus Flyby | | | | | | | | 2 | | | | | | | | | | | | | 2 |
| PL-16 | Pioneer Jup/Uranus Flyby (Uranus Probe) | | | | | | | | 1 | | | | | | | | | | | | | 1 |
| PL-17 | Pioneer Saturn Probe | | | | | | | | | 1 | | | | | | | | | | | | 1 |
| PL-18 | Pioneer Sat/Uranus Flyby (U Probe) | | | | | | | | | | 1 | | | | | | | | | | | 1 |
| PL-19 | Mariner Jupiter Orbiter | | | | | | | | | | 2 | | | | | | | | | | | 2 |
| PL-20 | Pioneer Jupiter Probe | | | | | | | | | | | | | 2 | | | | | | | | 2 |
| PL-21 | Mariner Saturn Orbiter | | | | | | | | | | | | | | 2 | | | | | | | 2 |
| PL-22 | Mariner Uranus/Nep Flyby | | | | | | | | | | | | | | | 2 | | | | | | 2 |
| PL-23 | Jupiter Sat. Orb/Lander | | | | | | | | | | | | | | | | | | | 1 | 1 | 2 |
| | Comets & Asteroids | | | | | | | | | | | | | | | | | | | | | |
| PL-24 | Dual Comet Flyby | | | | | 1 | | | | | | | | | | | | | | | | 1 |
| PL-25 | Encke Slow Flyby | | | | | | | | 1 | | | | | | | | | | | | | 1 |
| PL-26 | Encke Rendezvous | | | | | | | | | | 2 | | | | | | | | | | | 2 |
| PL-27 | Halley Flyby | | | | | | | | | | | | | | 1 | | | | | | | 1 |
| PL-28 | Asteroid Rendezvous | | | | | | | | | | | | | | | 2 | | | | | | 2 |
| | Total | | 1 | 1 | 2 | 2 | 2 | 2 | 5 | 2 | 7 | 0 | 3 | 4 | 5 | 5 | 2 | 0 | 2 | 2 | 2 | 49 |

Note: ○ Approved and Ongoing
△ Launched

TABLE 6. PLANETARY EXPLORATION PROGRAM (PL)

| PAYLOAD CODE | PAYLOAD | PAYLOAD OBJECTIVES AND DESCRIPTIONS | | |
|---|---|---|---|---|
| | | WEIGHT kg (lb) | DIMENSIONS (Length/Diameter) m (ft) | DESTINATION (Incl./Apo./Per.) km (n.mi.) |
| | <u>Approved Programs</u> | | | |
| PL-1 | Mariner Venus/Mercury | First mission to Mercury. First dual planet gravity assist mission. Science measurements will be made during interplanetary transit phase and at both planets. Primary objective is Mercury. Will define the topography, geological structure, and temperature variation of Mercury. Will determine atmospheric characteristics and composition and provide data for understanding ionosphere/solar wind interaction at Venus and Mercury. Instrumentation includes ultra-violet spectrometer, infrared radiometer, plasma science experiment, charged particle telescope, radio science/celestial mechanics, dual magnetometer, and two television cameras. | | |
| | | 528 (1163) | 3.9/2.1 (13/7) | Planet Flyby Venus 5300 (3300)/Mercury 1000 (625) |
| PL-2 | Pioneer Jupiter Flyby (Launched) | First missions to Jupiter. Will determine atmospheric composition and height, and mass and orbit of planet and satellites and measure magnetic field and radiation and thermal environment of Jupiter. In interplanetary space will measure variation in solar plasma and micrometeroid particle size and number. Spin-stabilized spacecraft has 13 experiments and is powered by radioisotope thermoelectric generators. | | |
| | | 260 (570) | 2.7/2.9 (9/9.8) | Flyby - Pioneer 10 213 000 (130 000) Pioneer 11 not yet determined. |

TABLE 6. PLANETARY EXPLORATION PROGRAM (PL)

| PAYLOAD CODE | PAYLOAD | PAYLOAD OBJECTIVES AND DESCRIPTIONS | | | |
|---|---|---|---|---|---|
| | | | WEIGHT kg (lb) | DIMENSIONS (Length/Diameter) m (ft) | DESTINATION (Incl./Apo./Per.) km (n.mi.) |
| PL-3 | Helios | Will investigate the properties of and the processes in interplanetary space in the direction of and within 0.3 AU of the Sun. Will provide information on the character of the solar wind and cometary phenomena and the distribution and flux of dust and asteroidal matter and the gradient of cosmic rays. Eleven experiments to be conducted using assorted instrumentation including mass and ultraviolet spectrometers, magnetometers, radiation detectors, and photometers. | 340 (750) | 2.8/4.2 (9/14) | Heliocentric Orbit at 0.3 AU |
| PL-4 | Viking 75 | For planet Mars, will describe the physical, chemical and thermal properties of the upper and lower atmosphere; search for life; describe physical, chemical, and magnetic properties of the surface; and investigate planet's seismic activity. Instruments will include cameras, life detectors, seismometer, radiometers, spectrometers, and soil analyzers. | 3700 (8100) | 4.5/3.6 (16/12) | Mars Orbit and Landing 33 000/1500 (17 800/810) |
| PL-5 | Mariner Jupiter/Saturn 77 | Will make comparative studies of the Jupiter and Saturn systems by obtaining measurements of the atmosphere, environment, and body characteristics of the planets and one or more of their satellites. Will study the nature of Saturn's ring and measure characteristics of the interplanetary medium. | | | |

TABLE 6. PLANETARY EXPLORATION PROGRAM (PL)

| PAYLOAD CODE | PAYLOAD | PAYLOAD OBJECTIVES AND DESCRIPTIONS | | |
|---|---|---|---|---|
| | | WEIGHT kg (lb) | DIMENSIONS (Length/Diameter) m (ft) | DESTINATION (Incl./Apo./Per.) km (n.mi.) |
| | Mariner Jupiter/Saturn 77 (Concluded) | Instruments will include television, photometer, ultraviolet and infrared spectrometers and radiometers, magnetometers, plasma probe, and trapped radiation, cosmic ray and solid particle detectors. | | |
| | | 750 (1650) | 5.6/3.7 (19/12) | Flyby (from center of planet)<br>Jupiter: 414 000 (216 000)<br>Saturn: 138 000 (72 000) |
| | <u>Inner Planets</u> | | | |
| PL-6 | Viking Orbiter/Lander 79 | Describe the physical, chemical and thermal properties of Mars upper and lower atmosphere. Search for life and describe physical, chemical and magnetic properties of the surface. | | |
| | | 3700 (8100) | 4.5/3.6 (16/12) | Mars Orbit and Landing<br>33 000/1500 (17 800/810) |
| PL-7 | Surface Sample Return | The objectives of this mission are to land on the Martian surface; collect a sample(s) of the soil and possibly the atmosphere; control the environment of the sample(s) during transit to Earth; and ensure a safe, contamination-free recovery at Earth. | | |

TABLE 6. PLANETARY EXPLORATION PROGRAM (PL)

| PAYLOAD CODE | PAYLOAD | PAYLOAD OBJECTIVES AND DESCRIPTIONS | | |
|---|---|---|---|---|
| | | WEIGHT kg (lb) | DIMENSIONS (Length/Diameter) m (ft) | DESTINATION (Incl./Apo./Per.) km (n.mi.) |
| | Surface Sample Return (Concluded) | 3300 (7300) | 4.8/4.6 (15.7/15) | Lander Direct Mars Entry |
| PL-8 | Satellite Sample Return | Will provide indication of the origin and evolution of the satellite systems and their role in solar system evolution. Will explore Phobos/Deimos and return surface sample from one of the satellites to Earth. Orbiting spacecraft instruments to include TV, IR radiometer, gamma-ray spectrometer, X-ray spectrometer/diffractometer. | | |
| | | 4000 (8800) | 7.6/4.6 (25/15) | Rendezvous and Landing on Moon of Mars. |
| PL-9 | Pioneer Venus | Will determine the nature and composition of Venus clouds, structure and composition of the lower atmosphere, upper atmosphere and ionosphere, interaction of solar wind with Venus ionosphere and magnetic field, surface and atmosphere characteristics on planetary scale by remote sensing, and gravitational field. Entry probes, bus and orbiter will carry complementary experiments. | | |
| | | 680 (1500) | 1.5/2.5 (5/8.3) | Orbiter 60°/150/66 000 (80/36 000) Probes enter in widespread pattern |

TABLE 6. PLANETARY EXPLORATION PROGRAM (PL)

| PAYLOAD CODE | PAYLOAD | PAYLOAD OBJECTIVES AND DESCRIPTIONS | | |
|---|---|---|---|---|
| | | WEIGHT kg (lb) | DIMENSIONS (Length/Diameter) m (ft) | DESTINATION (Incl./Apo./Per.) km (n.mi.) |
| PL-10 | Inner Planets Follow-On | Will continue inner planetary exploration employing basic Pioneer Venus spacecraft capability. Spacecraft and mission definition dependent upon prior missions. | | |
| | | 680 (1500) | 1.5/2.5 (5/8.3) | Probes and Orbiters to Mars and Venus |
| PL-11 | Venus Radar Mapper | Will map surface of Venus to a resolution of 10 to 100 m using radar from orbiting spacecraft. Relate cloud structure, temperature, and turbulence to surface structure. Continue measurements of fields and particles. Scientific payload could include imaging radar, IR and microwave radiometers, UV spectrometer, magnetometer, and plasma detector. | | |
| | | 3900 (8600) | 3.5/4.6 (11.5/15) | 90°/500 (270) Circular |
| PL-12 | Venus Buoyant Station | Buoyant Station will float at various altitudes in controlled increments. Will be used in conjunction with radar to probe atmosphere to distinguish turbulence, wind circulations, and major motions. Orbiter instruments might include atmospheric radar, laser altimeter, IR and microwave radiometer, UV and mass spectrometer, magnetometer, and photopolarimeter. | | |
| | | 5470 (12 000) | 3.5/4.6 (11.5/15) | Atmosphere of Venus |

TABLE 6. PLANETARY EXPLORATION PROGRAM (PL)

| PAYLOAD CODE | PAYLOAD | PAYLOAD OBJECTIVES AND DESCRIPTIONS | | |
|---|---|---|---|---|
| | | WEIGHT kg (lb) | DIMENSIONS (Length/Diameter) m (ft) | DESTINATION (Incl./Apo./Per.) km (n.mi.) |
| PL-13 | Mercury Orbiter | Will determine characteristics of surface and atmosphere, mass, shape, and size of planet, magnetic field, and interaction of solar wind with planet. Spacecraft equipment complement to be influenced by earlier flyby mission. Could include TV; IR radiometer; IR, X-ray, gamma-ray spectrometers; magnetometer; etc. | | |
| | | 3500 (7700) | 7.6/4.6 (25/15) | Two Orbiters:<br>90°/500 (270) Circular<br>60°/200/25 000 (110/13 500) |
| PL-14 | Venus Large Lander | Will provide measurement of the chemical and isotopic composition of surface material, local topography to the scale of cm to m, albedo and phase dependence of visible light, surface temperature, seismic activity, and surface radioactivity. Typical instruments might include TV cameras, spectrometers, seismometers, thermal probes, meteorology instruments. | | |
| | | 1690 (3700) | 5/4.6 (16.4/15) | Surface of Venus |
| | <u>Outer Planets</u> | | | |
| PL-15 | Mariner Jupiter/Uranus Flyby | Will study Jupiter and Uranus concentrating on environment, atmosphere, surface body characteristics, and their satellites; study the red spot of Jupiter. Type of sensors will include TV, IR spectrometer, UV radiometer and spectrometer, magnetometer, cosmic ray and trapped radiation detectors, plasma probe. | | |

TABLE 6. PLANETARY EXPLORATION PROGRAM (PL)

| PAYLOAD CODE | PAYLOAD | PAYLOAD OBJECTIVES AND DESCRIPTIONS | | |
|---|---|---|---|---|
| | | WEIGHT kg (lb) | DIMENSIONS (Length/Diameter) m (ft) | DESTINATION (Incl./Apo./Per.) km (n. mi.) |
| | Mariner Jupiter/Uranus Flyby (Concluded) | 750 (1650) | 5.6/3.7 (19/12) | Flyby (from center of planet) 10 radii of Jupiter Flyby radii of Uranus Optional |
| PL-16 | Pioneer Jup/Uranus Flyby (Uranus Probe) | Will define Uranus' atmospheric structure, composition, and dynamic processes. Entry probe may include instruments such as temperature and pressure gages, mass spectrometer, and accelerometers. | | |
| | | 582 (1283) | 2.9/2.9 (9.5/9.5) | Entry of Uranus Atmosphere |
| PL-17 | Pioneer Saturn Probe | Will define Saturn's atmospheric structure, composition, and dynamic processes. Entry probe may include instruments such as temperature and pressure gages, mass spectrometer, and accelerometers. | | |
| | | 570 (1250) | 3.1/3.1 (10/10) | Entry of Saturn's Atmosphere |
| PL-18 | Pioneer Saturn/Uranus Flyby (Uranus Probe) | Will define Saturn/Uranus atmospheric structure, composition, and dynamic processes. Determine characteristics of interplanetary space out to the orbit of Uranus and near environments of Saturn. Instruments for the probe may include temperature and pressure gages, spectrometer, and accelerometers; the space-craft bus may have radiometers, and UV photometer, spectrometers, etc. | | |
| | | 510 (1100) | 3.1/3.1 (10/10) | Entry of Saturn or Uranus Atmosphere |

TABLE 6. PLANETARY EXPLORATION PROGRAM (PL)

| PAYLOAD CODE | PAYLOAD | PAYLOAD OBJECTIVES AND DESCRIPTIONS | | |
|---|---|---|---|---|
| | | WEIGHT kg (lb) | DIMENSIONS (Length/Diameter) m (ft) | DESTINATION (Incl./Apo./Per.) km (n. mi.) |
| PL-19 | Mariner Jupiter Orbiter | Will perform comprehensive and detailed investigations of Jupiter, its satellite, atmosphere, fields, and particles. Instrumentation may include TV, IR radiometer and spectrometer, photopolarimeter, magnetometer, and plasma and radiation detectors | | |
| | | 2700 (5900) | 5.2/4.6 (17/15) | 0° /4 x 45 Jupiter radii<br>60° /2 x 60 Jupiter radii |
| PL-20 | Pioneer Jupiter Probe | Will determine Jupiter's atmospheric structure, elemental and isotopic abundances, and cloud characteristics. Will make remote measurements of the characteristics of the atmospheres of some of its satellites. Will refine measurements of the characteristics of interplanetary space. Probe instruments may include mass spectrometer, temperature and pressure gages, and accelerometers; spacecraft bus instruments may include IR radiometer, UV photometer, etc. | | |
| | | 520 (1150) | 3.1/3.1 (10/10) | Probe Entry into Jupiter's Atmosphere |
| PL-21 | Mariner Saturn Orbiter | Will determine characteristics of the planet and its satellites such as size, mass, radiation, and solar wind effects. Rings would be mapped and their size, particle distribution, and composition determined. Investigations would be made with TV, radiometers, spectrometers, magnetometers, plasma and radiation detectors, and pressure and temperature gages. | | |
| | | 1515 (3340) | 7.6/4.6 (25/15) | 0° /3 x 59 Saturn radii |

TABLE 6. PLANETARY EXPLORATION PROGRAM (PL)

| PAYLOAD CODE | PAYLOAD | PAYLOAD OBJECTIVES AND DESCRIPTIONS | | |
|---|---|---|---|---|
| | | WEIGHT kg (lb) | DIMENSIONS (Length/Diameter) m (ft) | DESTINATION (Incl. Apo. Per.) km (n. mi.) |
| PL-22 | Mariner Uranus/Neptune Flyby | Will determine mass distribution and magnetic field characteristics of Uranus and Neptune, characteristics of atmosphere and radiation belts, and interaction of solar wind and galactic radiation with planets. Scientific payload complement may consist of radiometers; magnetometer; dust, plasma, and radiation detectors; spectrometers; etc. | | |
| | | 915 (2000) | 7.6/4.6 (25/15) | Flyby (from center of planet) 2-5 radii of Each Planet |
| PL-23 | Jupiter Satellite Orbiter/Lander | Will provide understanding of Jupiter satellite as a step toward understanding origin and history of satellite systems and their relationship to the parent planet. Provide measurements of shape, mass, and dynamics; surface features; temperatures; composition; and atmosphere. Instrument package may include TV, X-ray diffractometer, alpha/proton spectrometer, seismometer, and magnetometer. | | |
| | | 9745 (21 500) | 7.6/4.6 (25/15) | 100 (55) Circular Orbit of Planet's Moon |
| | <u>Comets & Asteroids</u> | | | |
| PL-24 | Dual Comet Flyby | Will investigate existence and physical nature of cometary nucleus, structure and composition of the cometary atmosphere, interaction of the comet with the solar wind, and mechanisms of ion and radical production. Existing | | |

TABLE 6. PLANETARY EXPLORATION PROGRAM (PL)

| PAYLOAD CODE | PAYLOAD | PAYLOAD OBJECTIVES AND DESCRIPTIONS | | |
|---|---|---|---|---|
| | | WEIGHT kg (lb) | DIMENSIONS (Length/Diameter) m (ft) | DESTINATION (Incl./Apo./Per.) km (n. mi.) |
| | Dual Comet Flyby (Concluded) | instrumentation designed for studying the atmospheres and ionospheres of the planets will be utilized. | | |
| | | 454 (1000) | 3.9/1.4 (13/4.6) | Flyby of Two Comets |
| PL-25 | Encke Slow Flyby | Will determine the nature and constituents of the nucleus and coma, and investigate formative mechanisms. Will obtain gross indication of mass, dimension, dynamics, composition and velocity of neutral gases, ions, and solid particles. Instruments may include mass and UV spectrometers, IR radiometer, magnetometer, plasma probe. | | |
| | | 2035 (4490) | 3.9/3.7 (12.8/12) | Flyby: 5000 (2700) of Nucleus |
| PL-26 | Comet Encke Rendezvous | Will determine physical state, composition, and dimensions of comet Encke nucleus, rate at which nucleus releases material and variation of rate with solar distance, and composition of neutral gases and ions. Instrument payload may consist of TV, mass spectrometer, plasma probe, spectrophotometer, dust mass velocity detector, IR radiometer, dust composition analyzer, etc. | | |
| | | 2200 (4850) | 5/4.6 (16.4/15) | Rendezvous: 100 (55) |
| PL-27 | Comet Halley Flyby | Will identify existence of cometary nucleus. Will perform measurements of fields and particles of the active coma, halo, and tail and their interaction with the solar wind. Science instruments may include TV, mass spectrometer, dust | | |

TABLE 6. PLANETARY EXPLORATION PROGRAM (PL)

| PAYLOAD CODE | PAYLOAD | PAYLOAD OBJECTIVES AND DESCRIPTIONS | | |
|---|---|---|---|---|
| | | WEIGHT kg (lb) | DIMENSIONS (Length/Diameter) m (ft) | DESTINATION (Incl./Apo./Per.) km (n. mi.) |
| | Comet Halley Flyby (Concluded) | mass/velocity detector, dust composition analyzer, and plasma detector, etc. | | |
| | | 580 (1300) | 3.5/3.1 (11.5/10) | Flyby: 10 000 (5500) of Nucleus |
| PL-28 | Asteroid Rendezvous | Will determine mass, dimensions, dynamics, surface features, composition, and age of asteroids in order to understand the evolutionary processes of formation. Limited fields and particles measurements of the interaction of the asteroid with the solar wind might be possible. Instrument payload could include TV; IR radiometer; IR, gamma-ray, and X-ray spectroscopes; magnetometer; and gravity gradiometer. | | |
| | | 2000 (4400) | 5.0/4.6 (16.5/15) | Rendezvous: 3 asteroid radii |

## TABLE 7. LUNAR EXPLORATION PROGRAM (LUN)

### Program Description

The payloads of the Lunar Exploration Program are oriented towards scientific problem solving. NASA is presently engaged in an active program to analyze and interpret the large amount of lunar data collected by the Ranger, Surveyor, Lunar Orbiter, and Apollo Missions, including data still being received from experiments left on the Moon. While these efforts are resulting in an unprecedented expansion of new knowledge about the Moon, they are also raising scientific questions and disagreements that can only be resolved by further investigations by lunar orbit and surface payloads.

These missions would collect data in scientific fields already under study and new data from instrument types not yet flown as well as data from geological provinces not yet visited. In addition, they would be designed to supply information needed for determining the locations, the technology requirements, the scientific objectives for future manned lunar bases, and the feasibility of exploiting lunar materials to support the bases.

TABLE 7. LUNAR EXPLORATION PROGRAM (LUN)

| Payload Code | Payload | CY | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Automated Spacecraft | | | | | | | | | | | | | | | | | | | | | |
| LUN-1 | Lunar Polar Orbiter | | | | | | | | 1 | | | | | | | | | | | | | 1 |
| LUN-2 | Lunar Orbiter | | | | | | | | | | | | | 1 | | 1 | | | | | | 2 |
| LUN-3 | Lunar Rover | | | | | | | | | | | | | | | | 1 | 1 | | | | 2 |
| LUN-4 | Lunar Halo | | | | | | | | | | | | | | | | | | 1 | | | 1 |
| LUN-5 | Lunar Sample Return | | | | | | | | | | | | | | | | | | | 1 | 1 | 2 |
| | Total | | | | | | | | 1 | | | | | 1 | | 1 | 1 | 1 | 1 | 1 | 1 | 8 |

TABLE 7. LUNAR EXPLORATION PROGRAM (LUN)

<table>
<tr><th rowspan="2">PAYLOAD CODE</th><th rowspan="2">PAYLOAD</th><th colspan="3">PAYLOAD OBJECTIVES AND DESCRIPTIONS</th></tr>
<tr><th>WEIGHT<br>kg (lb)</th><th>DIMENSIONS<br>(Length/Diameter)<br>m (ft)</th><th>DESTINATION<br>(Incl./Apo./Per.)<br>km (n. mi.)</th></tr>
<tr><td></td><td><u>Automated Spacecraft</u></td><td colspan="3"></td></tr>
<tr><td rowspan="2">LUN-1</td><td rowspan="2">Lunar Polar Orbiter</td><td colspan="3">Will provide remote sensing geochemical X- and gamma-ray mapping, gravimetry, and magnetometry. Investigate lunar surface characteristics. Scientific instrument payload would include X-ray and gamma-ray spectrometers, magnetometer, and instrumentation to determine gravity characteristics. Spacecraft system includes a subsatellite launched from scientific orbiter.</td></tr>
<tr><td>460/1000</td><td>1.5/1.5 (5/5)</td><td>90°/110 (60) Circular</td></tr>
<tr><td rowspan="2">LUN-2</td><td rowspan="2">Lunar Orbiter</td><td colspan="3">Will provide imaging for photogeology, selective high resolution photography, remote sensing, compositional mapping, gravimetry, and communications. Investigate near-Moon environment. Scientific instrument payload would include TV; IR radiometer; IR, X-ray, gamma-ray spectrometers; altimeter; and bistatic radar.</td></tr>
<tr><td>700 (1500)</td><td>1.5/2.3 (5/7.5)</td><td>90°/100 (55) Circular</td></tr>
<tr><td rowspan="2">LUN-3</td><td rowspan="2">Lunar Rover</td><td colspan="3">Will perform traverse geophysics, geochemistry, and geology over great distances (100 km/year). Instrument complement to include in situ age dating equipment, X-ray diffractometer, elemental analyzers, and transverse gravimeter.</td></tr>
<tr><td>4000 (8800)</td><td>7.3/3 (24/10)</td><td>Lunar Surface</td></tr>
</table>

TABLE 7. LUNAR EXPLORATION PROGRAM (LUN)

| PAYLOAD CODE | PAYLOAD | PAYLOAD OBJECTIVES AND DESCRIPTIONS | | |
|---|---|---|---|---|
| | | WEIGHT kg (lb) | DIMENSIONS (Length/Diameter) m (ft) | DESTINATION (Incl./Apo./Per.) km (n. mi.) |
| LUN-4 | Lunar Halo Satellite | Will provide relay communication with lunar far side. Instrument complement would include communication, command, and tracking equipment. | | |
| | | 1000 (2200) | 7.3/2.7 (24/9) | L-2 Libration Point/ 64 500 (35 000) |
| LUN-5 | Lunar Sample Return | Will provide capability to return to Earth's surface lunar sample from any location on the lunar surface. Sample return system to be carried by a rover. Sample return spacecraft will be equipped with core tubes for returned samples. | | |
| | | 5300 (11 700) | 7.3/3 (24/10) | Lunar Surface |

# TABLE 8. LIFE SCIENCES PROGRAM (LS)

## Program Description

In order to gain a thorough understanding of the space environment on living systems, the payloads of the Life Sciences Program will provide a capability for exploring basic biological and physical mechanisms and for observing and measuring changes over time in biological systems. From such an understanding there will develop countermeasures and support systems to extend man's capability to live and work in space. Concurrently, investigations will be conducted to explore operational problems and potential solutions associated with man in space.

This comprehensive program to study weightlessness and its interaction with other variables of the spaceflight environment will be conducted on a range of subjects, from living cells to complete biological systems. These will be carried out in an automated spacecraft, which can be left in orbit for long periods of time or in the Shuttle dedicated laboratories and carry-on payloads. The operation of the laboratories will be by discipline scientists to provide on-board analytical expertise and sophisticated observation and manipulation of the experiments. In addition and whenever possible, the Life Sciences Flight Program will utilize the unique environment of space for the purpose of obtaining scientific knowledge in medicine, biology, behavior, and life support processes.

TABLE 8. LIFE SCIENCES PROGRAM (LS)

| Payload Code | Payload | CY | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Automated Spacecraft | | | | | | | | | | | | | | | | | | | | | |
| LS-1 | Life Sciences Research Module | | | | | | 1 | | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 26 |
| | Total Autom. | | | | | | 1 | | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 26 |
| | Sortie Payloads | | | | | | | | | | | | | | | | | | | | | |
| LS-2 | Laboratory and Carry-On Payloads | | | | | | | | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 28 |

TABLE 8. LIFE SCIENCES PROGRAM (LS)

| PAYLOAD CODE | PAYLOAD | PAYLOAD OBJECTIVES AND DESCRIPTIONS | | |
|---|---|---|---|---|
| | | WEIGHT kg (lb) | DIMENSIONS (Length/Diameter) m (ft) | DESTINATION (Incl./Apo./Per.) km (n.mi.) |
| | Automated Spacecraft | | | |
| LS-1 | Life Sciences Research Module | Will provide a means of conducting life science experiments in the weightless environment. Will study the operational capabilities and process parameters of life support and protective systems equipment. | | |
| | | 180 (400) | 2/1 (6.8/3) | 28.5° /Low Earth Orbit |
| | Sortie Payloads | | | |
| LS-2 | Laboratory and Carry-On Payloads | Will perform research in wide range of experiment areas (bio-engineering, space medicine, bio-research, space systems research) from molecular level studies to biological systems analysis to investigation of total organisms. Emphasis on man-related space flight problems. Will evaluate experimental teleoperator systems as precursors to operational systems as well as development of apparatus technology and operational concepts for efficient utilization of man in space. | | |
| | | 17 000 (37 500) (Includes Expendables) | 17.8/4.3 (58.5/14) | 28.5° /Low Earth Orbit |

TABLE 9. EARTH OBSERVATIONS PROGRAM (EO)

Program Description

The payloads of the Earth Observation Program make it possible to accomplish the required research and development to support known and anticipated needs of users such as the Department of Commerce, the Department of Agriculture, the Department of the Interior, and the private sector. This support is provided in the following disciplines: weather and climate observation, pollution monitoring, and Earth resources survey.

Reliable short- and long-term weather forecasts mean savings of life, property, and money through effective disaster warning systems and proper planning in many activities such as agricultural and transportation enterprises. Weather observation payloads will develop new technology to support and enhance the more improved operation of the nation's and world's weather services.

In order to achieve progress while living in harmony with his environment, man must learn to control pollution. In order to effectively utilize the world's natural resources, man must survey their extent and develop systems for wisely managing their use. The expansion of Earth resources and pollution monitoring payloads is based on growing demands for global systems to assist in the management of the world's resources and in the monitoring and control of pollution.

Implementation of the program objectives of Earth Observation will be achieved with two basic groups of automated payloads, one group in low altitude, Sun synchronous polar orbits and the other in geosynchronous orbits. The research and development activities of these payloads will be enhanced by the additional support offered by special-purpose automated and Sortie Lab payloads.

TABLE 9. EARTH OBSERVATIONS PROGRAM (EO)

| Payload Code | Payload | CY 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Automated Spacecraft | | | | | | | | | | | | | | | | | | | | |
| EO-1 | Earth Resources Tech. Sat. | | | | 1 | | | | | | | | | | | | | | | | 1 |
| EO-2 | NIMBUS | | 1 | | | 1 | | | | | | | | | | | | | | | 2 |
| EO-3 | Earth Observatory Sat. | | | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 15 |
| EO-4 | Syn. Earth Obs. Sat. | | | | | | | | | 1 | | 1 | | 1 | | 2 | | 2 | | 2 | 9 |
| EO-5 | Special Purpose Sat. | | | | 1 | 1 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 19 |
| EO-6 | TIROS | | | | | 1 | | | | | 1 | | | | | 1 | | | | | 3 |
| EO-7 | Syn. Meteorological Sat. | 1 | 1 | | | | 1 | | | | | | | | | 1 | | | | | 4 |
| | Total Autom. | 1 | 2 | | 2 | 3 | 3 | 3 | 3 | 4 | 3 | 3 | 2 | 4 | 2 | 6 | 2 | 4 | 2 | 4 | 53 |
| | Sortie Payloads | | | | | | | | | | | | | | | | | | | | |
| EO-8 | (Weather Simulation Lab., Sensor R&D) | | | | | | | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 24 |

Note:
○ Approved and Ongoing

TABLE 9. EARTH OBSERVATIONS PROGRAM (EO)

| PAYLOAD CODE | PAYLOAD | PAYLOAD OBJECTIVES AND DESCRIPTIONS | | |
|---|---|---|---|---|
| | | WEIGHT kg (lb) | DIMENSIONS (Length/Diameter) m (ft) | DESTINATION (Incl./Apo./Per.) km (n.mi.) |
| | Automated Spacecraft | | | |
| EO-1 | Earth Resources Technology Satellite (ERTS) | Will sense heat radiated by surface features in order to locate, map, and measure pollution in lakes, bays, and estuaries and to provide data on suitability of soil for cultivation and resources for exploitation. Investigations will be conducted using multispectral scanner, return beam vidicon camera, and data collection system. | | |
| | | 900 (2000) | 3.7/1.5 (12/5) | 90°/912 (490) Circular |
| EO-2 | NIMBUS | Will test sensors designed to extend satellite measurements of the atmosphere's vertical temperature and moisture content to cloud covered areas and to higher altitudes and make atmospheric composition measurements for establishing global baseline data for polluting constituents of the air. Instrumentation will include assortment of radiometers, spectrometers, and imagers. | | |
| | | 900 (2000) | 3.7/1.5 (12/5) | 90°/1100 (600) Circular |
| EO-3 | Earth Observatory Sat. (EOS) | Will perform environmental quality, meteorological, oceanographic, and Earth resources surveying by advance remote sensing techniques. Will carry advanced instrumentation such as the thematic mapper and next generation multispectral scanner. High resolution pointable imager, radar, microwave radiometer. | | |
| | | 2950 (6500) | 11/2.7 (36/9) | 99°/914 (494) Circular |

TABLE 9. EARTH OBSERVATIONS PROGRAM (EO)

| PAYLOAD CODE | PAYLOAD | PAYLOAD OBJECTIVES AND DESCRIPTIONS | | |
|---|---|---|---|---|
| | | WEIGHT kg (lb) | DIMENSIONS (Length/Diameter) m (ft) | DESTINATION (Incl./Apo./Per.) km (n.mi.) |
| EO-4 | Synchronous Earth Observatory Sat. (SEOS) | Will investigate and develop remote sensing techniques for measurement of the Earth's transient environmental phenomena from synchronous altitude. SEOS will utilize spacecraft base of EOS and carry multidisciplinary instrument complement — radiometers and multispectral scanners. | | |
| | | 2300 (5000) | 3.7/2.4 (12/8) | 0°/Synchronous Orbit |
| EO-5 | Special Purpose Satellite | Will test experimental application of research and technology developments in spacecraft and sensor subsystems. Will provide quick reaction to objectives identified by application disciplines and enable the conducting of special purpose missions dedicated to developing advanced sensors and instrumentation. In geosynchronous orbits, much of the emphasis will be devoted to evaluating various atmospheric sounding techniques. | | |
| | | 230 (500) | 2.1/1 (7/3) | 0°-90°/Low Earth to Sync. Orbit |
| EO-6 | TIROS | Will determine atmospheric pressure and density, vertical temperature and wind profiles, and sea-state, convection, and surface temperature using advanced sensing and observing techniques. | | |
| | | 1977: 337 (742) | 1.9/1 (6.2/3.3) | 102°/1460 (790) Circular |
| | | 1977 On: 635 (1400) | 3.7/2.4 (12/8) | 102°/1460 (790) Circular |

TABLE 9. EARTH OBSERVATIONS PROGRAM (EO)

| PAYLOAD CODE | PAYLOAD | PAYLOAD OBJECTIVES AND DESCRIPTIONS | | |
|---|---|---|---|---|
| | | WEIGHT kg (lb) | DIMENSIONS (Length/Diameter) m (ft) | DESTINATION (Incl./Apo./Per.) km (n.mi.) |
| EO-7 | Synchronous Meteorological Satellite | Will be a prototype operational geostationary meteorological satellite based on proven technology. Will observe major storms and atmospheric parameters and collect data from fixed ground platforms. Will utilize visible and infrared spin scan radiometer to provide day and night weather pictures. | | |
| | | 250 (550) | 3.1/1.9 (10.3/6.3) | 0°/Synchronous Orbit |
| | <u>Sortie Payloads</u> | | | |
| EO-8 | (Weather Simulation Lab., Sensor R&D) | Will perform experiments on the dynamics of meteorological phenomena and will simulate conditions associated with cloud physics. Will conduct specially dedicated missions for the remote sensing and study of Earth Resources and the environment. Will perform sensor development for all Earth observations disciplines. Will verify sensor measurement concepts.<br>Note: Earth Observations, Earth and Ocean Physics, and Communications and Navigation Sortie payloads flown together. | | |
| | | 11 300-12 200 (25 000-27 000) (Includes Expendables) | 18.3/4.3 (60/14) | 28.5°-90°/Low Earth Orbit |

# TABLE 10. EARTH AND OCEAN PHYSICS APPLICATIONS PROGRAM (EOP)

## Program Description

The payloads of the Earth and Ocean Physics Applications Program (EOPAP) will provide capabilities to identify, develop, and demonstrate relevant space techniques that will contribute significantly to the practical application of the Earth and ocean dynamics disciplines.

Earthquakes are one of nature's most terrifying phenomena causing large scale destruction and loss of life when they occur near large population centers. EOPAP payloads will apply space techniques to obtain important data for understanding earthquakes which may lead to the development and validation of predictive models for earthquake hazard assessment and alleviation. Very important to maritime industries and oceanographic communities is accurate information on sea-state, surface conditions, and circulation. EOPAP payloads will also be concerned with developing the basic technology that could lead to monitoring, reporting, and predicting ocean circulation and surface conditions on a global scale.

These practical tools, prediction models and observational systems to be developed by EOPAP, can ultimately be used by such operating agencies as the Department of Commerce, Defense, and Interior to provide substantive benefits to mankind.

TABLE 10. EARTH AND OCEAN PHYSICS APPLICATIONS PROGRAM (EOP)

| Payload Code | Payload | CY 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Automated Spacecraft | | | | | | | | | | | | | | | | | | | | |
| EOP-1 | Geodetic Earth Orbiting Sat. | | 1 | | | | | | | | | | | | | | | | | | 1 |
| EOP-2 | Laser Geodynamic Sat. | | | | 1 | | | | | | | | | | | | | | | | 1 |
| EOP-3 | SEASAT | | | | | 1 | | | | | 1 | | | | | | | | | | 2 |
| EOP-4 | GEOPAUSE | | | | | | | 1 | | | 1 | | | | | | | | | | 2 |
| EOP-5 | Grav. Gradiometer | | | | | | | | 1 | | | | | | | | | | | | 1 |
| EOP-6 | Mini-Laser Geodynamic Sat. | | | | | | | | 1 | | | | | 1 | | | | | | | 2 |
| EOP-7 | GRAVSAT | | | | | | | 1 | | | | | | | | | | | | | 1 |
| EOP-8 | Vector Magnetometer Sat. | | | | | | | | | 3 | | | | | 3 | | | | 3 | | 9 |
| EOP-9 | Magnetic Monitor Sat. | | | | | | | | | 1 | | | | | 1 | | | | 1 | | 3 |
| | Total Autom. | | 1 | | 1 | 1 | | 2 | 2 | 4 | 2 | | | 1 | 4 | | | | 4 | | 22 |
| | Sortie Payloads | | | | | | | | | | | | | | | | | | | | |
| EOP-10 | (Earth and Ocean Dynamics Experiments) | | | | | | | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 24 |

Notes:

○ Approved and Ongoing

TABLE 10. EARTH AND OCEAN PHYSICS APPLICATIONS PROGRAM (EOP)

| PAYLOAD CODE | PAYLOAD | PAYLOAD OBJECTIVES AND DESCRIPTIONS | | |
|---|---|---|---|---|
| | | WEIGHT kg (lb) | DIMENSIONS (Length/Diameter) m (ft) | DESTINATION (Incl./Apo./Per.) km (n.mi.) |
| | <u>Automated Spacecraft</u> | | | |
| EOP-1 | Geodetic Earth Orbiting Sat. (GEOS) | Will demonstrate the feasibility of measuring ocean surface topography by a satellite-to-ocean altimeter; will determine the feasibility of measuring deflection of the vertical and wave height; and will investigate solid Earth dynamics phenomena and refine orbit determination and gravity models. | | |
| | | 270 (600) | 1.3/1.2 (4.1/3.9) | 115°/840 (460) Circular |
| EOP-2 | Laser Geodynamic Sat. (LAGEOS) | Will make possible maximum accuracy range measurement for both geometric and orbital mode determinations of positions on the Earth which will permit the determination of plate tectonic regional fault motions, polar motion, and rotational variation. Will utilize very dense satellite equipped with laser retroreflectors to perform first laser range measurements not degraded by errors originating in the target satellite. | | |
| | | 680 (1500) | 0.6/0.6 (2/2) Sphere | 90°/3700 (2000) Circular |
| EOP-3 | SEASAT-A | Will demonstrate global-scale monitoring and reporting of a wide range of physical ocean phenomena, including sea-state, the location and transport of currents, global circulation patterns, ocean tides, wind stress, and geoid undulations. Instrumentation will include imaging IR radiometer, microwave scatterometer, etc. | | |
| | | 1000 (2200) | 4.6/4 (15/13) | 90°/600 (325) Circular |

TABLE 10. EARTH AND OCEAN PHYSICS APPLICATIONS PROGRAM (EOP)

| PAYLOAD CODE | PAYLOAD | PAYLOAD OBJECTIVES AND DESCRIPTIONS | | |
|---|---|---|---|---|
| | | WEIGHT kg (lb) | DIMENSIONS (Length/Diameter) m (ft) | DESTINATION (Incl./Apo./Per.) km (n.mi.) |
| | SEASAT-B (Concluded) | Will monitor and report on a global basis ocean surface phenomena such as seastate geoid undulations, wind stress on surface water, location and extent of boundary currents and other sea-surface topography. Will be demonstration of real-time global monitoring of ocean dynamics conditions and near-real-time analysis and dissemination of SEASAT-B data to users. | | |
| | | 1000 (2200) | 4.6/4 (15/13) | 90°/600 (325) Circular |
| EOP-4 | GEOPAUSE | Will establish a Space Reference Network System consisting of a pair of GEOPAUSE spacecraft for determination of the orbital altitudes of Ocean Dynamics Monitoring Spacecraft in the decimeter range, simultaneous monitoring of polar motion and Earth rotation variations, detailed determination of crustal motions in three dimensions for tracing both the global patterns of tectonic plate dynamics and the local behavior near fault zones. Will utilize accelerometers as part of a closed loop drag compensated system. | | |
| | | 1170 (2580) | 2.5/2 (8.2/6.5) | 90°/30 000 (16 200) Circular |
| EOP-5 | Gravity Gradiometer | Will utilize gravity gradiometer to obtain an improved map of the Earth's entire gravity field. The horizontal resolution of satellite-determined gravity models currently available is of the order of 1500 km. A gravity gradiometer will offer the potential to improve resolution over the entire Earth to a few hundred kilometers. | | |
| | | 3000 (6600) | 4.6/4 (15/13.3) | 90°/200 (108) Circular |

TABLE 10. EARTH AND OCEAN PHYSICS APPLICATIONS PROGRAM (EOP)

| PAYLOAD CODE | PAYLOAD | PAYLOAD OBJECTIVES AND DESCRIPTIONS | | | |
|---|---|---|---|---|---|
| | | | WEIGHT kg (lb) | DIMENSIONS (Length/Diameter) m (ft) | DESTINATION (Incl./Apo./Per.) km (n.mi.) |
| EOP-6 | Mini-LAGEOS | Will provide a series of dense satellites at varying Earth orbits equipped with laser retroreflectors to measure with broad coverage plate motions, regional motions, polar motions, and rotational variations and to better determine the Earth's gravity field. | 100 (220) | 0.5/0.5 (1.6/1.6) | 28.5°, 55°, 90°/650 (350) Circular |
| EOP-7 | GRAVSAT | Will map the Earth's gravity field in sufficient detail to reflect the structure of the Earth's crust as it applies to the understanding of plate tectonics (which is fundamental to earthquake mechanisms), and the formation of mineral resources. | 2400 (5300) | 2.7/2 (8.9/6.6) | 90°/200 (108) Circular |
| EOP-8 | Vector Magnetometer Satellite | Will obtain high-resolution global data on the fine structure and variations of the magnetic field for use in (a) studies of crustal motion and subcrustal processes, and (b) an identification of mineral deposits. | 150 (330) | 1.3/1.4 (4.3/4.6) | 90°/400 (216) Circular |
| EOP-9 | Magnetic Monitor Satellite | Will measure changes in the Earth's magnetic field stemming from extra-terrestrial influences, so as to provide current reference fields in support of the low-altitude Vector Magnetometer Satellite measurements of localized | | | |

TABLE 10. EARTH AND OCEAN PHYSICS APPLICATIONS PROGRAM (EOP)

| PAYLOAD CODE | PAYLOAD | PAYLOAD OBJECTIVES AND DESCRIPTIONS | | |
|---|---|---|---|---|
| | | WEIGHT kg (lb) | DIMENSIONS (Length/Diameter) m (ft) | DESTINATION (Incl./Apo./Per.) km (n.mi.) |
| | Magnetic Monitor Satellite (Concluded) | magnetic field changes associated with crustal motions and subcrustal phenomena. | | |
| | | 200 (440) | 1.3/1.4 (4.3/4.6) | 28°/2000 x 1000 (1080 x 540) |
| EOP-10 | Sortie Payloads<br>(Earth and Ocean Dynamics Experiments) | Will perform experiments related to better determination of Earth and ocean dynamics using such instruments as radar altimeter, microwave scatterometer, laser profilometer, precise multi-imaging radar, and FM correlation radar. Will conduct measurements of geomagnetic field using magnetometers. Will use the Shuttle pallet in the Sortie mode to develop and validate new spaceborne sensors and instrumentation for Earth dynamics and ocean dynamics measurements.<br><br>Note: Earth Observations, Earth and Ocean Physics, and Communications and Navigation Sortie payloads flown together. | | |
| | | 11 300-12 200 (25 000-27 000) (Includes Expendables) | 18.3/4.3 (60/14) | 60° /Low Earth Orbit |

# TABLE 11. COMMUNICATIONS AND NAVIGATION PROGRAM (C/N)

## Program Description

The payload schedule of the Communications and Navigation Program is based on the private sector assuming the responsibility for the research and development necessary for early commercial applications of communications and navigation satellites. In recognition of the potential benefits from these satellites, a vigorous program has been pursued from the inception of the space age that has clearly demonstrated the viability of satellite-based communications systems. The first two payloads on the program schedule represent the culmination of NASA's planned communications systems and technology development.

Experiment payloads flying in the Sortie Lab will focus on evaluating communications and navigation technologies which relate to anticipated NASA needs.

TABLE 11. COMMUNICATIONS AND NAVIGATION PROGRAM (C/N)

| Payload Code | Payload | CY | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Automated Spacecraft | | | | | | | | | | | | | | | | | | | | | |
| C/N-1 | Applic. Tech. Sat. | | | 1 | | | | | | | | | | | | | | | | | | 1 |
| C/N-2 | Coop. Applic. Sat. | | | | 1 | | | | | | | | | | | | | | | | | 1 |
| | Total | | | 1 | 1 | | | | | | | 0 | | 0 | 0 | 0 | 0 | 0 | | | | 2 |
| | Sortie Payloads | | | | | | | | | | | | | | | | | | | | | |
| CN/3 | (Antenna Configurations Laser Technology, Traffic Management Techniques, Energy Transfer Experiment) | | | | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 11 |

Note:

○ Approved and Ongoing

TABLE 11. COMMUNICATIONS AND NAVIGATION PROGRAM (C/N)

<table>
<tr><th rowspan="2">PAYLOAD CODE</th><th rowspan="2">PAYLOAD</th><th colspan="3">PAYLOAD OBJECTIVES AND DESCRIPTIONS</th></tr>
<tr><th>WEIGHT<br>kg (lb)</th><th>DIMENSIONS<br>(Length/Diameter)<br>m (ft)</th><th>DESTINATION<br>(Incl./Apo./Per.)<br>km (n. mi.)</th></tr>
<tr><td></td><td><u>Automated Spacecraft</u></td><td colspan="3"></td></tr>
<tr><td rowspan="2">C/N-1</td><td rowspan="2">Applications Technology Satellite</td><td colspan="3">Will provide an oriented, stable spacecraft platform at synchronous altitude for advanced technology experiments in the categories of communications, meteorology, spacecraft technology and science. Will contribute to antenna technology and study interferometry, precision station-keeping, and millimeter wave communications techniques.</td></tr>
<tr><td>1360 (3000)</td><td>7.5/3 (25/9)</td><td>0°/Synchronous Orbit</td></tr>
<tr><td rowspan="2">C/N-2</td><td rowspan="2">Cooperative Applications Satellite</td><td colspan="3">Will advance technologies for future space-based communications systems involving test of high power, 12 GHz superefficient power tubes, and deployable solar power arrays.</td></tr>
<tr><td>346 (760)</td><td>2.1 (7)/2.1 (7)</td><td>0°/Synchronous Orbit</td></tr>
<tr><td></td><td><u>Sortie Payloads</u></td><td colspan="3"></td></tr>
<tr><td rowspan="2">C/N-3</td><td rowspan="2">Com/Nav Sortie (Antenna Configurations Laser Technology, Traffic Management Techniques)</td><td colspan="3">Will conduct experiments to advance the technology associated with high performance antennas, high power vacuum tubes, precision attitude determination, and laser communications.<br>Note: Earth Observations, Earth and Ocean Physics, and Communications and Navigation Sortie payloads flown together.</td></tr>
<tr><td>11 300-12 200 (25 000-27 000) (Includes Expendables)</td><td>18.3/4.3 (60/14)</td><td>60°/Low Earth Orbit</td></tr>
</table>

## TABLE 12. SPACE PROCESSING PROGRAM (SP)

### Program Description

The Sortie Lab payloads of the Space Processing Program will exploit the unique characteristics of space flight to prepare and process materials in ways not possible or practical on Earth. These characteristics are weightlessness, a vacuum sink of unlimited capacity, and energy in the form of solar radiation. The payloads will utilize these resources to foster new knowledge of materials, technologies, and systems directly applicable to ground-based industrial processes and to develop unique, high-technology products that can be commercially manufactured in space for use on Earth.

The numbers given in Table 12 should be understood as indicating a total level of activity equivalent in requirements to given numbers of dedicated missions, and not as a firm requirement specifically for dedicated sorties; for example, the one payload in 1980 is made up of modular space processing equipment which can be divided to share Shuttle flights with other payloads. The Space Processing Program prefers a greater frequency of shared missions over less frequently dedicated missions for the modular equipment defined as a payload.

TABLE 12. SPACE PROCESSING PROGRAM (SP)

| Payload Code | Payload | CY | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | <u>Sortie Payloads</u> | | | | | | | | | | | | | | | | | | | | | |
| SP-1 | (Crystal Growth, Biological Separation, Metallurgy) | | | | | | | | | 1 | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 43 |

TABLE 12. SPACE PROCESSING PROGRAM (SP)

| PAYLOAD CODE | PAYLOAD | PAYLOAD OBJECTIVES AND DESCRIPTIONS | | |
|---|---|---|---|---|
| | | WEIGHT kg (lb) | DIMENSIONS (Length/Diameter) m (ft) | DESTINATION (Incl./Apo./Per.) km (n.mi.) |
| | <u>Sortie Payloads</u> | | | |
| SP-1 | Space processing modules for work in:<br>Metallurgy<br>Crystal Growth<br>Electronic Materials<br>Biological Applications<br>Ceramics and Glass<br>Chemical Processes<br>Physical Processes in Fluids | Will provide capabilities that can be matched to the resources of most Shuttle missions for R& D on materials science and technology in a weightless environment. Payloads will be made up from components provided in a large inventory of general purpose experimental apparatus, including control and instrumentation equipment, furnace heat treating apparatus, levitation heat treating systems, biological processing equipment, and diverse general purpose apparatus for experiments falling outside the above principal divisions. Equipment in the inventory will be modified to meet the needs of experimental investigators as they evolve, and updated to incorporate advances in technology during the life of the program. | | |
| | | 2300-11 800)<br>(5000-26 000)<br>(Includes Expendables) | 1.5-18.3/4.3 (5-60/14) | 28.5°/Low Earth Orbit |

# TABLE 13. SPACE TECHNOLOGY PROGRAM (ST)

## Program Description

The payloads of the Space Technology Program will exploit the Shuttle capabilities to extend applicable ground-based technology programs into the space environment where specific investigations require prolonged weightlessness and/or the unique characteristics of the space environment to supplement or verify ground-based data. Typically, these investigations are necessary steps in the development and application of new materials, new sensors, new subsystems, and new concepts. In addition, this program will also provide for a new exploitation of space, as an environment in which to accomplish fundamental physics and chemistry research that cannot be done on the ground.

TABLE 13. SPACE TECHNOLOGY PROGRAM (ST)

| Payload Code | Payload | CY 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Automated Spacecraft | | | | | | | | | | | | | | | | | | | | |
| ST-1 | Long Duration Exposure Mod. | | | | | | | | | | | | | | | | | | | | 6 |
| | Total Autom. | | | | | | | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 6 |
| | Sortie Payloads | | | | | | | | | | | | | | | | | | | | |
| ST-2 | (Advanced Technology Lab, Fluid Physics, Gas Chemistry, Contamination Monitoring) | | | | | | | | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 46 |

TABLE 13. SPACE TECHNOLOGY PROGRAM (ST)

| PAYLOAD CODE | PAYLOAD | PAYLOAD OBJECTIVES AND DESCRIPTIONS | | |
|---|---|---|---|---|
| | | WEIGHT kg (lb) | DIMENSIONS (Length/Diameter) m (ft) | DESTINATION (Incl./Apo./Per.) km (n.mi.) |
| | <u>Automated Spacecraft</u> | | | |
| ST-1 | Long Duration Exposure Facility | Will determine the synergistic effects of the space environment on over 1300 $ft^2$ of infrared surface experiments for 6 to 9 months duration. Will test biological specimens, meteoroid bumper configurations, solar cells, optical surfaces, thermal coatings, materials, etc. | | |
| | | 3800 (8500) | 9.2/4.3 (30/14) | 28.5°/500 (270) Circular |
| | <u>Sortie Payloads</u> | | | |
| ST-2 | Space Technology Sortie (Advanced Technology Lab, Fluid Physics, Gas Chemistry, Contamination Monitoring) | Will provide orbiting facility to stimulate the development of new space technology and incorporation of new technology into operational systems and verify advanced sensors and space systems components. Will perform fundamental research in physics and chemistry that cannot be done on the ground. Will provide instrumentation to assess contamination external to the spacecraft, in real time. | | |
| | | 11 500 (25 300) (Includes Expendables) | 18.3/4.3 (60/14) | 57°/Low Earth Orbit |

TABLE 14. NON-NASA/NON-DoD PAYLOADS (NN/D)

Section Description

The Non-NASA/Non-DoD payloads represent NASA's projection of the payload traffic of the user community that will result from the transfer and operational application of the technology generated by NASA's programs for space applications. Specifically they are the Earth Observations, Space Processing, and Earth and Ocean Physics Application Programs. In the communications and navigation area, payload estimates are based on technology contributed by NASA's Communications and Navigation Program, but also on investments in research and development by private enterprise. The projection for the 1980 through 1991 period represents Shuttle payload traffic. Foreign Sortie payloads represent projected useage of the Space Lab as provided to NASA by the European Space Research Organization.

TABLE 14. NON-NASA/NON-DoD PAYLOADS (NN/D)

| Payload Code | Payload | CY 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Comm/Nav | | | | | | | | | | | | | | | | | | | | |
| NN/D-1 | International Comm. | 3 | 1 | 2 | 1 | 1 | 1 | 2 | 3 | | | 2 | 3 | 2 | 2 | | | 2 | 3 | 2 | 30 |
| NN/D-2 | U.S. Domestic | | 7 | 3 | 1 | 1 | 4 | 1 | 1 | 2 | 2 | 4 | 1 | 1 | 2 | 2 | 6 | 2 | 2 | 1 | 43 |
| NN/D-3 | Disaster Warning | | | | | | | | | 1 | 1 | | | 1 | | | | | 1 | | 4 |
| NN/D-4 | Traffic Management | | | | 2 | 1 | 3 | 1 | 2 | 2 | 1 | 1 | 1 | | 1 | | 1 | | 1 | | 17 |
| NN/D-5 | Foreign Comm. | 2 | 1 | 3 | 2 | 3 | 1 | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 23 |
| NN/D-6 | Communication R&D/Prototype | | | | | | | | | | | | | 1 | | | 1 | | 1 | | 3 |
| | Earth Observations | | | | | | | | | | | | | | | | | | | | |
| NN/D-7 | Tiros Operational Sat. | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | 7 |
| NN/D-8 | Environ. Monitoring Sat. | | | | | | | | 1 | 1 | 1 | | | 1 | 1 | 1 | 1 | | 1 | 1 | 9 |
| NN/D-9 | Foreign Syn. Met. Sat. (2 Systems) | | | | | | 1 | | | 1 | 1 | | 1 | | 1 | | 1 | | 1 | | 7 |
| NN/D-10 | Geosyn. Oper. Environmental Sat. | | | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | 1 | | 1 | | 1 | 1 | 1 | | 1 | 13 |
| | Earth Resources Sat. | | | | | | | | | | | | | | | | | | | | |
| NN/D-11 | Low Earth Orbit (2 Systems) | | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 15 |
| NN/D-12 | Geosynchronous | | | | | | | | | | | | | | | | 2 | | 2 | | 4 |
| NN/D-13 | Foreign Syn. Earth Obs. Sat. | | | | | | | | | | | | | | | | 1 | 2 | | 1 | 4 |
| | Earth and Ocean Physics | | | | | | | | | | | | | | | | | | | | |
| NN/D-14 | Global Earth & Ocean Monit. Sys. | | | | | | | | | | | | | | 3 | | 3 | | 3 | | 9 |
| | Total Autom. | 6 | 10 | 10 | 8 | 9 | 13 | 7 | 8 | 10 | 9 | 10 | 8 | 9 | 12 | 6 | 19 | 9 | 17 | 8 | 188 |
| | Sortie Payloads | | | | | | | | | | | | | | | | | | | | |
| NN/D-15 | Space Manufacturing | | | | | | | | | | | | | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 10 |
| NN/D-16 | Foreign Sortie | | | | | | | | 2 | 3 | 3 | 4 | 3 | 4 | 3 | 4 | 3 | 4 | 3 | 4 | 40 |

TABLE 14. NASA ESTIMATED NON-NASA/NON-DoD MISSION PAYLOADS (NN/D)

| PAYLOAD CODE | PAYLOAD | PAYLOAD OBJECTIVES AND DESCRIPTIONS | WEIGHT kg (lb) | DIMENSIONS (Length/Diameter) m (ft) | DESTINATION (Incl./Apo./Per.) km (n. mi.) |
|---|---|---|---|---|---|
| | Comm/Nav | | | | |
| NN/D-1 | International Comm. | Provide large capacity global communication links via leased-lines services to users in North and South America, Africa, Far and Near East. | 1770 (3900) | 2.7/2.5 (9/8.3) | 0°/Synchronous Orbit |
| NN/D-2 | U. S. Domestic-A | Provide leased domestic communications relay services to users in the 50 states and Puerto Rico. Reliable service must be maintained by provisions for one active satellite in orbit, one backup satellite in orbit, and one ready satellite in ground reserve. | 260 (576) | 2.2/1.7 (7.1/5.5) | 0°/Synchronous Orbit |
| | U. S. Domestic-B | Provide advanced-capacity leased domestic communications relay services to users in the 50 states and Puerto Rico. | 1770 (3900) | 2.7/2.5 (9/8.3) | 0°/Synchronous Orbit |
| | U. S. Domestic-C | Will develop a Tracking and Data Relay Satellite System for greatly improved support of low altitude Earth orbiting space missions. The TDRSS will provide nearly continuous coverage of these missions, simplifying their operation and will also make possible a significant reduction in the number of ground stations in the Space Tracking and Data Network (STDN). | 300 (700) | 4.2/1.9 (13.7/6.3) | 0°/Synchronous Orbit |

TABLE 14. NASA ESTIMATED NON-NASA/NON-DoD MISSION PAYLOADS (NN/D)

| PAYLOAD CODE | PAYLOAD | PAYLOAD OBJECTIVES AND DESCRIPTIONS | | |
|---|---|---|---|---|
| | | WEIGHT kg (lb) | DIMENSIONS (Length/Diameter) m (ft) | DESTINATION (Incl./Apo./Per.) km (n. mi.) |
| NN/D-3 | Disaster Warning | Will provide synchronous satellite to maintain continuous communications before, during, and after a disaster. Will consist of two satellites in synchronous orbit for reliable coverage of the United States and its surrounding oceanic area. | | |
| | | 580 (1280) | 5.1/1.4 (16.8/4.7) | 0°/Synchronous Orbit |
| NN/D-4 | Traffic Management | The Traffic Management Satellite provides a high-quality voice and data communications link between civil air- and sea-borne traffic and shore-based installations. Position location information is also supplied. | | |
| | | 315 (695) | 3.2/2.2 (10.6/7.2) | 0°/Synchronous Orbit |
| NN/D-5 | Foreign Communication Satellite | Will serve as the satellite link in providing intracountry and regional telecommunications including educational and community television. | | |
| | | 310 (680) | 2.4/1.6 (7.8/5.3) | 0°/Synchronous Orbit |
| NN/D-6 | Communication R&D/ Prototype | Advance the technology of space communications, data management and navigation to meet future NASA and other agency requirements. Evaluate the satellite systems and spacecraft technology for possible prototype demonstrations in education, health care services, etc. | | |
| | | 960 (2100) | 4.6/2.3 (15/7.6) | 0°/Synchronous Orbit |

TABLE 14. NASA ESTIMATED NON-NASA/NON-DoD MISSION PAYLOADS (NN/D)

| PAYLOAD CODE | PAYLOAD | PAYLOAD OBJECTIVES AND DESCRIPTIONS | | |
|---|---|---|---|---|
| | | WEIGHT kg (lb) | DIMENSIONS (Length/Diameter) m (ft) | DESTINATION (Incl./Apo./Per.) km (n.mi.) |
| | <u>Earth Observations</u> | | | |
| NN/D-7 | Tiros Operational Satellite | Will serve as satellite link in providing synoptic global atmospheric and cloud cover data to assist in the preparation of weather forecasts. | | |
| | | 630 (1400) | 3.8/2.1 (12.5/7) | 103°/1700 (920) Circular |
| NN/D-8 | Environmental Monitoring Satellite | Will provide information on atmospheric and oceanographic pollution on a global basis. | | |
| | | 635 (1400) | 3.7/2.4 (12/8) | 102°/1460 (790) Circular |
| NN/D-9 | Foreign Synchronous Meteorological Satellite | Will be operational meteorological satellite operating from synchronous altitude for continuous observation of the atmosphere. | | |
| | | 250 (550) | 3.1/1.9 (10.3/6.3) | 0°/Synchronous Orbit |
| NN/D-10 | Geosynchronous Operational Meteorological Satellite | Will be operational meteorological satellite operating from synchronous altitude for continuous observation of the atmosphere, particularly for large storm tracking. System will consist of two satellites located over east and west coast. | | |
| | | 250 (550) | 3.1/1.9 (10.3/6.3) | 0°/Synchronous Orbit |

TABLE 14. NASA ESTIMATED NON-NASA/NON-DoD MISSION PAYLOADS (NN/D)

| PAYLOAD CODE | PAYLOAD | PAYLOAD OBJECTIVES AND DESCRIPTIONS | | | |
|---|---|---|---|---|---|
| | | | WEIGHT kg (lb) | DIMENSIONS (Length/Diameter) m (ft) | DESTINATION (Incl./Apo./Per.) km (n.mi.) |
| NN/D-11 | Low Earth Orbit Earth Resources Satellite | Will be operational satellite to continually survey Earth resources to provide synoptic Earth resources data to the user community. System will consist of spacecraft, aircraft, tracking and data acquisition stations. | 2950 (6500) | 11/2.7 (36/9) | 99°/914 (494) Circular |
| NN/D-12 | Geosynchronous Earth Resources Satellite | Will provide comprehensive, broad coverage of Earth resources for user community from geosynchronous platform. | 2300/5000 | 3.7/2.4 (12/8) | 0°/Synchronous Orbit |
| NN/D-13 | Foreign Synchronous Earth Observations Satellite | Will be operational Earth observations satellite at synchronous altitude for continuous observation of environmental quality, meteorological oceanographic, and Earth resources. | 2300 (5000) | 3.7/2.4 (12/8) | 0°/Synchronous |
| | <u>Earth and Ocean Physics</u> | | | | |
| NN/D-14 | Global Earth & Ocean Monitoring System | Will serve as the satellite link in providing operational systems for earthquake hazard assessment and alleviation, physical oceanography and ocean management, and magnetic field mapping. | 1100 (2500) | 3.7/1.8 (12/6) | 98°/371 (200) Circular |

TABLE 14. NASA ESTIMATED NON-NASA/NON-DoD MISSION PAYLOADS (NN/D)

| PAYLOAD CODE | PAYLOAD | PAYLOAD OBJECTIVES AND DESCRIPTIONS | | |
|---|---|---|---|---|
| | | WEIGHT kg (lb) | DIMENSIONS (Length/Diameter) m (ft) | DESTINATION (Incl./Apo./Per.) km (n. mi.) |
| | <u>Sortie Payloads</u> | | | |
| NN/D-15 | Space Manufacturing Sortie | Will perform experiments in the following general areas of science and technology: metallurgical processes, electronic materials, biological applications, and nonmetallic materials and processes. Equipment will include furnace heat treating equipment, levitation heat treating equipment, and biological processing equipment.<br><br>It is expected that non-NASA/non-DoD space processing activity will share apparatus and missions with the corresponding NASA activity to a considerable extent and, like the NASA activity described in Table 12, will tend to share missions with payloads involving other disciplines. Therefore, the numbers of Sorties listed for this activity in Table 14 should be taken as an indication of the estimated level of effort, rather than as an estimated requirement for these specific numbers of dedicated Sorties. | | |
| | | 2300-2800 (5100-6200) (Includes Expendables) | 1.5/4.3 (5/14) | Low Earth Orbit |
| NN/D-16 | Foreign Sortie | Will perform experiments in stellar astronomy, high energy astrophysics, solar physics, and aeronomy applications, life sciences, and space technology. | | |
| | | 12 000 (26 500) (Includes Expendables) | 13.7-18.3/4.3 (45-60/14) | 28.5°-90°/Low Earth Orbit |